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DIFFERENTIAL DIAGNOSIS OF PAIN IN THE CHEST

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IN this discussion the term "pain" will be used to include all uncomfortable sensations, such as fullness, tightness, constriction, burning, numbness or pressure, as well as actual pains of various sorts. The term "chest" will include the cardiac area for pain, which extends from the third cervical above to the eighth dorsal below. This includes the arms, the whole of the anterior part of the chest, but, posteriorly, only that part above the eighth interspace, the neck and the upper part of the epigastrium. Anginal pain does, although rarely, overflow this area above and radiate to parts of the face and mouth. Investigation of such pains forms the most frequent and important of the problems dealt with by physicians specially interested in cardiac disease. During the last fifteen months of practice over 600 such cases, all new, have come into the office for consultation. Old cases or repeats are excluded in this series, as it is desired to give as truly as possible the proportional number of each cause. Including repeats would give an undue proportion of coronary cases.

Of this group 225 had pain that was considered to be of cardiac origin, *viz.*, 37.4 per cent. So that, if the average patient thinks he has a cardiac pain the chances are nearly two to one that this is not so. Of this 225 group, 87 had angina only; 73 had coronary occlusion only; 47 others had both coronary thrombosis with angina, either before or after, or both; and the remaining 18 had pain due to other forms of heart disease. Of these 18, four had angina due to aortic valve disease; 1 had angina due to luetic aortitis; 3 had pain during attacks of paroxysmal tachycardia; 3 cases were due to pericarditis, 1 to coronary embolism, 1 to contusion of the heart, 1 to disordered action of the heart, and the remaining 4 to various other forms of valvular disease. Thus, 207 out of 225, or 92 per cent of the cases with cardiac pain, had coronary disease as its cause.

Of the non-cardiac group of 392 cases the pain in 201, or roughly 50 per cent, was due to root involvement by spondylitis. In these cases the diagnosis of spondylitis was certain, and in many of them some spinal movement induced the pain of which they complained. In another 35 the diagnosis of spondylitis was probable, because of the type of the pain. In 52 cases, however, or 8 per cent of the total 600, no cause whatever was found for the pain, which was certainly non-cardiac in origin, because the pains were unlike cardiac pains in location, duration and character, and the heart was normal functionally, anatomically and electrocardiographically. It is probable that most of this group also had pains of spondylitic origin. This group is very similar to the second group, excepting that in this one there was less arthritic evidence. A case was put in the second group, and labelled probably spondylitic, when there were pains in a variety of places, such as down the arms or down the legs or in several different places in the chest, or if there were a history of lame back or arthritis in other situations, when on physical examination there was no limitation of movement or pain on spinal movements. No x-ray plates were taken to demonstrate spondylitis, because the diagnosis was not considered important enough to justify the expense to the patient.

The next group in the non-cardiac division, 43 in number, had shoots or stabs of pain like pin-pricks, that is, pains lasting only a second

or so, which usually came in various places on the left side of the front of the chest. In 15 of these 43 no associated disease was demonstrable; 9 were noted to have spondylitis; 6 had various forms of valvular disease; 2 had disordered action of the heart; and 1, tuberculosis. It is my impression that this form of pain is relatively more common than the figure (7 per cent of all chest pains) would indicate, because its mention was omitted in many histories on account of its insignificance. I am strongly of the opinion that this form of pain is never due to coronary disease. A reasonable explanation, however, of these little stabs is extremely difficult and will not be ventured.

Only 14 of the non-cardiac group had pain due to gall-bladder disease, with or without gall stones. This number is obviously much too small. These 14 are merely the total number of cases in which someone thought the pain might be of cardiac origin, but which, however, on investigation turned out to be due to gall-bladder disease, the heart being entirely normal. The 14 do not include any of the cases of cholecystitis which accompanied the 207 cases of coronary disease, of which there must have been many. The question of how many patients with angina or coronary occlusion had associated gall-bladder disease was not investigated, although quite a large number had pains due to both.

A miscellaneous group of 25 cases had chest pains due to pleurisy, including pneumonia, and carcinoma of the bronchus, local injury, cancer of the breast, aneurysm, spinal curvature, globus hystericus, cardiospasm and duodenal ulcer. A final 22 represents a group in which no definite decision could be arrived at, but most of which were cases having pain that might have been cardiac, because heart disease was present with no other demonstrable cause for pain. This group includes cases of which the following are examples.

A man, aged 50, with mitral stenosis and auricular fibrillation, with a good exercise tolerance, had had constant pain around the left nipple for four years, unaffected by walking, but made worse by fatigue or by lying on the left side.

A woman, aged 64, had had three attacks in five months, commencing with a sharp stab of pain, for a few seconds only, in the left breast, followed by weakness and unconsciousness for half an hour. Vomiting occurred in one attack. Physical, x-ray and electrocardiographic examinations were all negative. The heart was said to be very fast during the attacks. However, she could walk two or three miles on the level at an ordinary gait comfortably. These cases might have been paroxysmal tachycardia.

A patient with hypertensive heart disease, pulsus alternans, and congestive failure had two attacks of pain across the top of both shoulders behind, above the scapular spines, which lasted all day and occurred two weeks apart.

During this same period 38 cases of congestive failure, 70 cases of chronic valvular disease, and 40 cases of paroxysmal tachycardia were seen as new cases in the office, all without pain. These figures indicate that about 7 or 8 per cent of cases of paroxysmal tachycardia produce cardiac pain, and that real cardiac pain in chronic valvular disease is rare. Associated spondylitic pain was found to be as common with valvular disease as was pain that might have been cardiac, such as in the cases cited above. A review of the above case histories showed that 5 per cent of the cases of angina and coronary thrombosis had other associated pains due to spondylitis. This figure is probably too low, because in some cases no mention was made of the latter pains on account of their relative unimportance.

Someone is going to wonder at the relative infrequency of pains due to syphilitic aortitis in this series, only one having been mentioned. It should therefore be explained that in office, and also in hospital practice, syphilitic aortitis is becoming more and more uncommon in Ontario. In the Toronto General Hospital twenty years ago, 12 per cent of those admitted had positive Wassermann reactions. Due to various measures, public health and others, this figure has gradually declined, until last year it was down to 1.9 per cent. It is now becoming difficult to find cases of syphilitic aortitis to show to medical students.

When investigating cases with chest discomforts, it is well to have in mind a classification of their possible causes, somewhat similar to the following.

A. Pains Due to Disease in the Chest Wall

1. Root neuritis, secondary to spondylitis.
2. Local neuritis, such as herpes zoster. The rash of this disease may be delayed as long as five weeks, or may not appear at all.
3. Involvement of the vertebral bodies by inflammation, tuberculosis, or new growth. These produce similar pains to vertebral arthritis, but are usually more severe, persistent and progressive. To avoid dismissing these cases as spondylitis it is very important to have radiographs made in suspected cases.
4. Local disease in the chest wall, such as chronic mastitis, new growth, injury or local tuberculosis.
5. Fractured rib. A fractured rib sometimes occurs, not due to direct violence. The writer saw three

such cases in one year, one due to a severe paroxysm of coughing, one to an asthmatic attack, and the third to a vigorous embrace.

6. Meningeal involvement from tumour, aneurysm or other disease within the spinal canal.

7. Idiopathic. There are many cases of a pain, especially in the region of the left breast, for which one cannot find the slightest suspicion of a cause. Many of the above so-called shoots or stabs fall in this group. One hesitates to mention fibrositis, because of the difficulty of certain diagnosis, unless one can feel small tender nodules. Pleurodynia, myalgia and intercostal neuralgia are not diagnostic terms. They are only used to indicate a pain of uncertain origin, and are useless, except to cover our inability to make a diagnosis.

B. Pains Due to Visceral Disease

1. Pleural pain is unilateral. Most of the causes of pleural pain are easily distinguished from heart disease. Coronary thrombosis has been mistaken for pneumonia when pulmonary infarction or pleural effusion occurred early. A spontaneous pneumothorax sometimes produces symptoms very like coronary thrombosis—the pain, rapid pulse, slight fever, etc. Complete pneumothorax is easily diagnosed by physical examination. A partial pneumothorax, however, may be very difficult to distinguish on physical examination, and may require stereo plates. A most difficult problem occasionally arises after an operation, to distinguish pulmonary embolism from coronary thrombosis. Points in favour of pulmonary embolism are the marked suddenness of onset, and distress due rather to dyspnœa than to actual pain, together with a demonstrable thrombo-phlebitis. It must be remembered that frequently pulmonary embolism occurs and no signs of a thrombo-phlebitis are evident until possibly a week or two later. Frequency of occurrence is much in favour of pulmonary embolism. A friction over an infarct might take on the character of a cardio-respiratory friction, and thus simulate cardiac infarction. Coronary thrombosis would have to be corroborated by some change in the heart or circulation apart from the electrocardiogram, because pulmonary infarction can produce changes in the electrocardiogram similar to those due to cardiac infarction.

2. Mediastinal tumours rarely produce pain, except by pressure on the chest wall or by involving the pleura or pericardium. The diagnosis of mediastinal tumour has to be made usually from aneurysm, and occasionally from a bronchogenic tumour extending into the mediastinum. Visible pulsation under a fluoroscope is not diagnostic, because tumours may pulsate and an aneurysm may not. Points in favour of aneurysm are a definite relation of the mass to some part of the aorta on x-ray examination, an expansile pulsation on palpation, a positive Wassermann test, and some cardiac involvement such as aortic insufficiency. Points in favour of tumour are irregularities in the shape of the mass, or multiple masses, or a mass isolated from the aorta, as might be determined by rotating the patient behind the fluoroscope. Absence of lues, nothing else wrong with the cardiovascular system, the presence of secondaries in the neck, and a history suggestive of malignancy are additional points.

3. Œsophageal obstruction or cardiospasm produce distress related to swallowing, and can be diagnosed by having the patient swallow barium under the fluoroscope, as well as by œsophagoscopic examination.

4. Gall bladder and gastric disturbances such as heartburn sometimes produce substernal or precordial distress. Heartburn presents no diagnostic difficulty, on account of its relation to meals and sour eructations. In cholecystitis, if pain be felt in the left breast or below the left breast, it lasts too long to be due to angina, is not related to exertion and may be related to meals. Sometimes pressure over the gall bladder area, on deep inspiration, produces pain referred to the region of the left breast or below it. A gall bladder type of indigestion and an x-ray of the gall bladder with dye will help to settle the question of cholecystitis with or without gall stones. In such cases, however, the heart must be investigated carefully in all respects.

5. A dissecting aneurysm may simulate coronary thrombosis exactly, even to producing the characteristic electrocardiographic changes, by obstructing the mouth of one of the coronary arteries. The pain of dissecting aneurysm however, may go over the abdomen or even down the legs. The blood pressure should be taken in all the limbs. Enlargement of the abdominal aorta may be demonstrated on palpation; a murmur may be heard over the abdominal aorta or femorals, due to the hæmorrhage into the wall of the artery bulging into the lumen of the vessel. An x-ray plate of the chest may show a scalloped outline to a widened thoracic aorta.

6. Cardiac pains. (*a*) Any cardiac disease, such as subacute bacterial endocarditis or rheumatic heart disease, especially when it is active, may have associated pain which is usually persistent and not very severe. This may or may not be changed by exercise. (*b*) Pericarditis produces direct pain, that is, not referred. The sensory nerves situated outside the parietal pericardium are directly stimulated. (*c*) Specific aortitis produces two types of pain. The commoner type is angina; that is, it comes on effort, lasts for a few minutes, and goes away with rest. Occasionally these patients get pains, especially at night, lasting a few minutes or a few hours, occurring chiefly in the top part of the chest. (*d*) Aneurysms also have two varieties of pain. The process of rupturing may produce pain; the other is due to pressure in the chest wall. (*e*) Some cases of paroxysmal tachycardia have pain during the attacks. (*f*) The so-called disordered action of the heart or neuro-circulatory asthenia cases are described as having an ache in the left chest. It is doubtful whether or not this is a real cardiac pain. In most of the cases seen recently it could be demonstrated that the pain of which these patients complained was not of cardiac origin, but was the basis of their cardiac neurosis. (*g*) Angina pectoris. (*h*) Coronary occlusion.

Angina is a term which is used with two meanings, or possibly three. Some physicians call every form of cardiac pain angina. Others, especially in England, use the term to include what we call angina together with coronary thrombosis, naming the former the angina of effort and the latter the angina of occlusion. The term in America, however, is usually restricted to effort pain, and is used in a diagnostic sense to apply to those cases in which there is any form of distress in the cardiac area mentioned above, and the surmise is that the patient has coronary disease. Otherwise, the case would be diagnosed as angina due to aortic insufficiency or stenosis or pernicious anæmia, etc.

Most people have the idea that angina is a severe, sudden pain. Both these descriptions are more or less untrue. It may be a slight discomfort, fullness, a sense of constriction or pressure, or any form of distress up to a severe pain. One characteristic which it almost never has is sharpness. It is never a shoot or a stab, and does not throb. It is always continuous;

that is, it lasts for a definite length of time, longer than a few seconds. It develops gradually, increases to a crisis, and dies away gradually. In most cases it is located in the middle line, and the farther to one side or other of the middle line that it occurs, the less likely is the pain to be cardiac. It is never localized to either axillary region. It may radiate to or beyond the axillary region from the middle line, but never occurs as an isolated pain on either side of the chest outside the anterior axillary line. It may radiate to one or both arms, to the shoulders, or the back, or the neck, or occasionally to the face, or it may commence in the back or almost any place in either arm, or it may be confined to a part of either or both arms, and never reach the chest. Its radiation to the left arm or to both arms has no serious significance; that is, a pain which radiates to the arms is no more serious than one that does not. Radiation to the arm is only important in differential diagnosis, as it pretty well excludes disease below the diaphragm. Further, radiation to the arm does not, as is sometimes thought, prove that a chest pain is of cardiac origin. Spondylitic pains just as frequently go down the arms. Some anginas may last as short a time as one minute, or as long as half an hour or even longer. Ordinarily, the discomfort lasts as long as the exertion continues, and dies down with a few minutes' rest. Therefore, when an angina is brought on by anxiety or apprehension it may be prolonged by panic even up to two hours, just as it may be prolonged by exertion. Half an hour is an average, arbitrary limit for the duration of angina. The attacks come on much more easily with walking after a meal, or the first thing in the morning, or in cold or windy weather. There is usually no dyspnœa with the attacks. After severe attacks the patient perspires, is weak and fatigued. One of the most common accompanying symptoms is the eructation of gas, which is no doubt a vagal reflex. The sense of impending death is related to the severity of the pain, plus the apprehension of the patient, and is of little diagnostic value, as it is much more frequent in hysterical attacks. It is naturally much more common in coronary thrombosis than in angina. Cutaneous or subcutaneous hyperæsthesia may accompany or follow the pain, as it occasionally does any pain, even a headache. It has no diagnostic or prognostic value, for it is just as often present with unimportant non-cardiac pains. It is more common in coronary thrombosis than in angina. The most important point about angina is the ease with which it is brought on. In the mild case, the distress occurs only hurrying up a hill, or walking fast soon after a meal. Finally, it may come walking a few yards, on slight excitement, or after a meal without exertion, or on stepping out into the cold or wind, or in bed possibly from a dream, or from no discernible cause. A patient may deceive one by stating that walking brings on the discomfort, when the pain actually occurs some hours after the exertion, possibly in bed that night. One should therefore make sure that the discomfort comes during the exertion and not some time after. Anginas are occasionally overlooked when the distress is in an uncommon area, such as the forearms, wrists or epigastrium. Another fairly common source of error occurs when a patient states that he gets epigastric or substernal distress after meals, when really the distress is produced by walking after a meal. There should be a more or less constant relation between the degree of exertion and the production of an anginal pain; that is, the pain should occur every time a certain degree of exertion is undertaken. Angina is not an occasional occurrence, but rather an inevitable one with a certain degree of exertion. If the pain be occasional it is probably not anginal, because a patient with spondylitis may get an occasional pain while walking, but will get the same pain more often while sitting or lying, and will usually be able to walk without getting it.

The pain of spondylitis is usually unilateral, very seldom in the middle line, and is characterized by its variability. It is sometimes sharp, sometimes dull, or a burning, or an ache or a tired feeling, having different characters in the same individual at different periods. It lasts any length of time, from a second to several days, or even months continuously. It occurs in different places in the chest from time to time, as well as in other parts of the body. It is these variations in character, duration and situation that distinguish it from angina. The patient with angina has the distress in the same situation, of the same character and duration. Anginas do occasionally reverse their radiation. In the same patient the pain usually starts sub-

sternally and goes down the arm; sometimes it may start in the arm and go to the chest. Spondylitic pains are frequently worse in bed, and are related to position in bed or other special postures, and are induced often by some special movement rather than by some special degree of exertion. They may be localized to a very small area, or they may involve one-half of the chest. They spread to different parts of the chest in a most unaccountable fashion. They may follow the direction of the interspaces, or go directly across the interspaces and have no apparent relation to the nerve segments. Another characteristic of spondylitic pains is that they are periodic. They may be absent for months or even years at a time.

To describe the distress of coronary thrombosis or cardiac infarction is a much more difficult problem. In general, one may say that the severity of the distress depends on the size of the vessel which is occluded or narrowed and the suddenness with which the obstruction is brought about. The whole of one coronary artery may be completely occluded slowly and gradually by fibrosis around its mouth, from syphilitic aortitis, without any pain or symptoms. There may be some other unknown factor, however, because sometimes patients with serious or fatal attacks have no pain. It has been found in more than one hospital that in 35 per cent of the fatal cases in which a fresh infarct was found at autopsy, the patients had gone through their last illness without pain. The pain therefore may vary from nothing at all to the most severe degree imaginable—one in which even morphine, given at the rate of one grain per hour, has scarcely any effect in producing relief. In general, compared to angina, the pain of coronary occlusion is of longer duration, greater severity, more widespread, and perhaps more often lower in the chest or epigastrium. Its duration is usually hours or days, instead of minutes, although mild cases may have pains lasting only a few minutes throughout the attack. Some cases (10 or 15 per cent) commence with anginal pain for a few days, or even two or three weeks, and then culminate in a severe prolonged pain. In a few cases the pains are anginal throughout, occurring only on effort. It would appear reasonable to believe that temporary anginas are really cases of cardiac infarction. How else can one explain the case in which angina, usually coming on rather suddenly, lasts a few days or weeks and then disappears completely? The cases with terrible pain are usually serious. One must not, however, conclude that the reverse is true, because quite a few patients with very mild pain die suddenly. In an ordinary case the pain of coronary occlusion lasts for hours or two or three days, and may keep recurring for two or three weeks. In some cases, it continues to recur for months, with occasional bouts of slight fever. These cases should be regarded as progressive or recurrent in nature, and at autopsy evidences of fresh extensions are found around the edge of the original infarct. The pain is of sudden onset in only 25 or 30 per cent of cases, and is usually unrelated to exertion. There are a few cases, however, which come on immediately after, or within twenty-four hours of violent exertion. These are very difficult to understand, unless Leary's explanation of rupture of a sub-intimal atheromatous area into the lumen of the coronary applies. It is important to recognize that coronary occlusion can and does, although rarely, result from violent exertion, because this point brings it within the scope of the Workmen's Compensation Act.

The diagnosis of angina is made on the history alone, and very frequently coronary thrombosis can be diagnosed on the history alone; what one finds on physical, x-ray or electrocardiographic investigation is merely confirmatory, and in 25 or 30 per cent of cases of angina everything in connection with the cardiac investigation is normal, excepting what one finds by inquiry. One of the chief objects of this paper is, if possible, to improve our methods of inquiry. It is of the utmost importance to get all the facts in connection with the pain from the patient himself and not from a second person. For this, patience, tact and dexterity are necessary, because people resent being closely cross-questioned after they have finished telling you what they think about themselves, or what someone else has told them. Some patients are much more interested in telling what they think produces their distress than they are in describing the actual distress. If you take second-hand information about the position, duration and character of the distress, you will often be led astray. One should therefore go about inquiry in these patients in a

systematic way, asking questions based on four different points in connection with the pain; first, the location, second the character, third the duration, and fourth, the factors influencing the pain.

Obviously the first question is, Where exactly is the pain situated and how low down does it go? Is the pain always in the same place or does it shift? If it occurs in two or more places in the chest, the chances are it is not cardiac. When a patient has multiple pains in the chest, each pain has to be taken individually and analyzed, because one of them might be anginal and the others not. Where else in the body does pain occur? If pains be present in various places, such as the back, neck, legs, arms, etc., the probability is that all the pains are of one common origin, which cannot be cardiac, because they shift from place to place and some of them occur outside the cardiac area for pain.

Questions about the character of the pain are not very important. Anginal pains are obviously of the same character in the same individual. They vary in severity but not in character. If however in one individual the pains do vary in character, being sometimes sharp and sometimes a dull ache, or sometimes a burning sensation, this variability practically proves they are not cardiac.

Questions in connection with duration are extremely important. The first is, How long does the pain last at one time continuously? Pains lasting only a second or so are probably not cardiac. They are too short for angina. If sometimes the pain lasts a few seconds or a few minutes, and sometimes a few hours, they are probably not cardiac. The next question is, When did the pain commence? If it began only a short time previously, such as a few days or a week or two, and lasts any length of time, short or long, it could be coronary occlusion. If, however, it began months or years before, and lasts hours or days continuously, it obviously could not be due to cardiac infarction, because it has occurred too often and lasted too long. If the pain began years before, and the patient has had intermissions of weeks or months, it could not be anginal because angina occurs continuously, although it may be better in the summer and worse in the winter. The first time an unaccountable pain occurs in the chest, especially in the middle line, or in an adult, no matter what its duration, but more especially if it lasts over an hour, the patient should be put to bed and kept there until cardiac infarction is excluded.

The fourth group of questions refers to factors influencing the pain. A good opening question is, Does the pain occur more frequently in bed or when up? The root pains of spondylitis are often or usually worse in bed and are improved by exercise. Is the pain related to position in bed? or rolling over in bed? Spondylitic pains are frequently induced by lying on one side or the other, and relieved by changing one's position, or they may be induced by a certain position in a chair or automobile. Does bending, reaching, or any special movement induce the pain? Can the patient do anything to induce the pain at will? Does walking bring on the pain? or walking fast? If walking induces it, does it do so regularly or occasionally? It is surprising how seldom walking induces spondylitic pain. Does the pain come on during exertion or afterward? Movements involving jarring often bring on spondylitic pains.

Some such detailed method of inquiry as that outlined above may be necessary to prove that a pain or pains are not of cardiac origin. The details are not at all necessary however in most real anginas, because the patients in the latter case will probably volunteer the information that they cannot walk far because they are stopped by some discomfort in their chests, or somewhere in the cardiac area for pain. The diagnosis of angina, therefore, is fairly easy and fairly certain, except in people who have a language difficulty or who give contradictory answers.

The diagnosis of coronary thrombosis is relatively easy in about 60 or 65 per cent of cases; in the remainder it is extremely difficult, and in many it is impossible. Think, for a moment, how many cases of coronary occlusion or cardiac infarction you diagnose in a year, in the absence of pain. When one does diagnose coronary thrombosis in the absence of pain, one feels that something quite creditable has been done. When however one approaches the question from the autopsy end widely different feelings are induced. If 35 or 37 per cent of fatal cases of cardiac infarction have no pain, what about the less serious ones who live?

Graded according to severity, there are four types of coronary thrombosis. The most severe group is made up of those dramatic cases where the sufferers drop dead or collapse, gasp for breath, become unconscious and die in a few minutes, or live for a few hours, with terrible agony or terrible dyspnœa. This group is comparatively small in number. The second is made up of those cases of average severity that are commonly diagnosed. These patients have persistent pain, usually across the chest, lasting a few hours or a few days, of gradual or sudden onset, with or without vomiting, shock, pallor, cyanosis, sweating, etc. Such cases are diagnosed easily and with a fair degree of certainty. This group is many times as numerous as the first, and carries a mortality of 30 or 40 per cent.

There is a still larger group of mild cases, frequently undiagnosed because they have atypical, slight, or mild pain, or no pain at all. In this group, the mild pain may be relieved by nitroglycerin, or whiskey, or heat. Some may have only an unaccountable attack of weakness, or dizziness, or shortness of breath, or fainting, and afterwards feel quite well. This group carries a much lower mortality, possibly 5 or 10 per cent. Whenever any sudden change occurs in the condition or function of the heart, cardiac infarction should be suspected. The following are some of the changes that might occur—a sudden lessening of the exercise tolerance; a sudden appearance of circulatory failure; an unaccountable increase in the degree of circulatory failure; the initial attack of a new rhythm, especially in a person of sclerotic age; the onset of any form of block or pulsus alternans; the initial attack of nocturnal dyspnœa, cardiac asthma, acute œdema of the lungs or angina; a marked increase in the frequency of attacks or angina or in the ease with which they are induced, or when they commence to come with rest in bed. In this third mild group, fever and leukocytosis may be absent, and there will likely be no change in the heart or circulation on physical examination. The best evidence in such cases are characteristic changes in the shape and direction of the T waves in a series of electrocardiograms, taken over a period of two or three weeks.

The fourth group is made up of cases without symptoms. That such a group exists we know from autopsy findings. One or more healed infarcts are frequently found post-mortem, of which there had been no signs or symptoms during life. Some of this group have their coronary thrombosis masked by some other serious disease, such as congestive failure. Others must have had their attacks and not known that anything had happened.

The diagnosis of coronary thrombosis is made on some of the following points.

First, the previous history. Seventy per cent of our series had a previous history of angina or dyspnœa on exertion.

Second, the nature of the attack is often alone sufficient for the diagnosis. If a patient, two months previously, began to have substernal distress in walking so far at a certain gait, and then one night, while at rest in bed, gets a similar sort of pain, but more severe, and lasting two or three hours or more, then the diagnosis of cardiac infarction is certain, without any confirmatory evidence. There are very few diseases that can produce a constricting pain all over the front of the chest and down both arms.

Third, a leukocytosis is present almost as soon as the pain occurs.

Fourth, a slight to moderate fever comes on, usually the second or third day, and lasts for a few days or a week or two.

Fifth, more serious cases show some change in the heart or circulation, such as a weak pulse, a rapid pulse, pulsus alternans, a new rhythm (such as auricular fibrillation, flutter, or ventricular tachycardia), pallor, cyanosis, sweating, shock, collapse, dyspnœa, weakness, faintness unconsciousness, delirium, gallop rhythm, œdema of the lungs or legs, enlargement of the liver, a fall in blood pressure, or a friction rub.

Sixth, embolism occurs in a considerable percentage of cases, commonly estimated at about 15. This frequently occludes the whole aorta at or near the bifurcation, because the mass of agglutinated platelets within the ventricle on the infarcted area is large.

Seventh, in doubtful cases, the electrocardiographic changes in the shape and direction of the T wave are most helpful, and often constitute the only confirmatory evidence. It must be realized, of course, that one electrocardiogram taken before or during an attack of coronary occlusion is of little value. Its diag-

nostic value is almost nil, because one does not know what it had been like previously. To be of diagnostic value, a series must be taken over a period of from two days to three or four weeks, because the characteristic changes may occur rapidly or slowly, and are some times delayed as long as three or even four weeks. As a general statement, one would be fairly safe in saying in a patient suspected of having coronary occlusion that if the T's remained fixed for three weeks, coronary occlusion could be excluded. In following this rule, one would certainly miss odd cases, but the chances are that most of them would be mild and unimportant. Further, it is necessary to remember that what changes might occur could be caused by other diseases, which therefore have to be excluded. Changes in the take-off, shape, and direction of the T waves due to cardiac infarction may be somewhat closely simulated in any form of active heart disease, including pericarditis; in myxœdema at the commencement of thyroid administration; in an anginal attack, where they last only a few minutes; in digitalis administration; and in any severe illness such as pneumonia, diabetic acidosis, or pulmonary embolism. They have been noted in delirium tremens. They can be produced temporarily in normal people by breathing an atmosphere low in oxygen. The writer has to confess that he has never been able to use the so-called significant Q or S waves for the diagnosis of cardiac infarction. Where they have been seen the diagnosis has already been established by more outstanding changes in the T waves.

When a pain occurs in and is confined to the epigastrium the chance of its being cardiac is greatly increased. In such a case the patient should be put to bed and examined for both coronary and abdominal disease, and the decision arrived at by the preponderance of evidence in favour of one or the other. In case, however, no decision can be reached, or where the case is in an isolated place and facilities for further investigation are wanting, the patient should be confined to bed for four or five weeks, on suspicion of its cardiac origin, especially when there is a very fair probability that it might be cardiac. The mistakes that are made nowadays are the reverse of those made ten or fifteen years ago. Then coronary thrombosis was not diagnosed when it should have been. Now it is diagnosed frequently when it should not be, in cases that obviously have pain due to gall bladder or other abdominal origin. It is a very common tendency when the profession has recently learned a new diagnosis to overwork it.

MYASTHENIA GRAVIS: A CLINICAL REVIEW OF EIGHTY-SEVEN CASES OBSERVED BETWEEN 1915 AND THE EARLY PART OF 1932*

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IN the spring of 1932 Dr. Walter Boothby[1] began his extensive investigation of myasthenia gravis at The Mayo Clinic. Recently, in his eighth report,[2] he published his observations on a series of 82 cases in which the patients had been under his supervision since 1932. As there is no available report regarding the results of treatment in a single large series of cases observed prior to the work of Boothby, it was deemed advisable to review the clinical records of patients examined at the clinic before the use of ephedrine, glycine, and prostigmin. With this plan in mind, the present study was undertaken, in the hope that we might be able to judge of the advance which has been made regarding this disease since 1932.

No attempt has been made in this study to review the literature on myasthenia gravis. Acknowledgment must be made to Miss Harriet Edgeworth[3] who introduced the use of ephedrine in the treatment of this malady. At The Clinic Dr. Henry Woltman was the first to appreciate

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This review includes only those cases of myasthenia gravis which were observed between 1915 and the early part of 1932. They are not to be confused with the cases which have been observed by Boothby since 1932.